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Study of cross-spectra of velocity components and temperature series in a nocturnal boundary layer

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The main characteristic of the Planetary Boundary Layer is the turbulent flow that can be understood as the motions of many superimposed eddies with different scales, which are very irregular and produce mixing among the atmospheric properties. Spectral analysis is a widely used statistical tool to know the size of eddies into the flow. The Turbulent Kinetic Energy is split in fractions for each scale of eddy by mean the power spectrum of the wind velocity components. Also, the fluctuation of the other variables as temperature, humidity, gases concentrations or material particles presents in the atmosphere can be divided according to the importance of different scales in a similar way than the wind. A Cross-spectrum between two time series is used in meteorology to know their correlation in frequency space. Specially, coespectrum, or real part of cross-spectrum, amplitud and coherence give us many information about the low or high correlation between two variables in a particular frecuency or scale (Stull, 1988).

In this work we have investigated cross-spectra of velocity components and temperature measured along the summer 2009 at the CIBA, Research Centre for the Lower Atmosphere, located in Valladolid province (Spain), which is on a quite flat terrain (Cuxart et al., 2000; Viana et al., 2009). In these experimental dataset, among other instrumentation, two sonic anemometers (20 Hz, sampling rate) at 1.5 m and 10 m height are available. Cross-spectra between variables of the two levels, specially, wind vertical component and sonic temperature, under stable stratification are studied in order to improve the knowledge of the proprieties of the momentum and heat fluxes near the ground in the PBL. Nevertheless, power spectral of horizontal components of the wind, at both levels, have been also analysed.

The spectra and cross-spectra were performed by mean the Blackman-Tukey method, widely utilised in the time series studies (Blackman & Tukey, 1958) and, where it is needed the correlation function of the time series analysed. Results will be regarding for different Richardson number and turbulent intensities, but always in nocturnal conditions, in order to evaluate the influence of the different turbulent and stratification degrees.

References.

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